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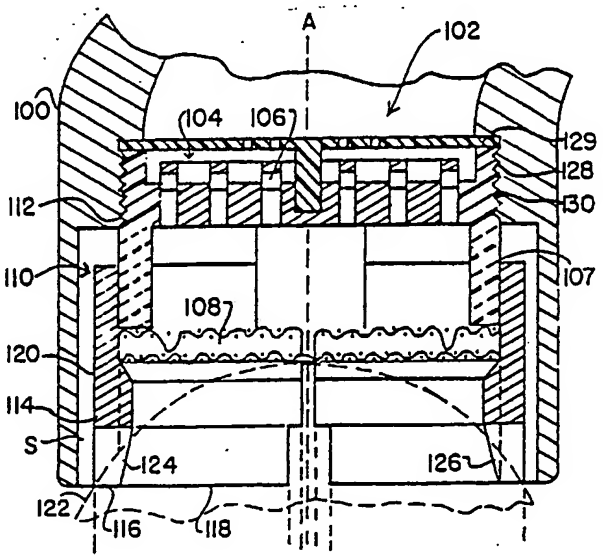
(54) Title: CONCEALED, LIQUID FLOW AERATOR

(57) Abstract

Aerator (102) which is substantially or entirely concealed within a spout (100) or the like. Liquid flowing through the spout (100) has air introduced into the flow by the aerator (102). The aerator (102) includes a tubular element (110) in which is contained a screen (108) and to which a jet forming element (104) is integrally coupled. Liquid flows through the jet forming element (104) which has a first flow cross-section and thereafter through the screen (108) which has a larger flow cross-section. The downstream portion (132) of the tubular element (110) terminates at a mouth (118). The screen (108) is recessed or recessable upstream from the mouth (118) enough to permit a coin (122) or the like to be inserted into indentations (124, 126) and twisted for easy aerator installation and removal. The jet forming element (104) and tubular element (110) are preferably molded into a unitary, plastic structure.



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Description

Concealed, Liquid Flow Aerator

Technical Field

My invention relates to a device for introducing air into a flowing liquid which is forced through a conduit or faucet, where the device is entirely or substantially entirely concealed within the conduit or faucet.

Background Art

Since the issuance of my basic patent, U.S. Patent No. 2210846, on a faucet aerator (entitled "Fluid Mixing Device"), there have been numerous efforts to shorten the aerator. The motives for shortening the aerator have included decreasing cost, enhancing appearance, and reducing the possibility of damage to the aerator. It has, in fact, been suggested that the aerator be enclosed or concealed within the spout of a faucet.

In concealing the aerator, however, it has been noted that the dimensions and proportions of the aerator must be changed due to the limited space available within the spout. In my British Patent 1189550, I disclosed an aerator in Figure 4 which screws into a spout. As shown in that embodiment, the outflow from the screen (numerals 14, 20) flows directly out of the aerator. In addition, two spaced rings (numerals 11, 28) are employed,

ring 11 coupling the aerator the spout and ring 28 abutting a lateral lip of the spout. These two effects result in a notable reduction in the cross-section of the liquid flow exitting the aerator. Specifically, it has been observed that the cross-section of flow from a spout end having a 21.5 mm diameter has been approximately 14.5 mm with the embodiment of Figure 4. Another concealed aerator currently being manufactured has an outer diameter of 20.5 mm, but yields an outflow stream of only 14 mm. The attendant loss of flow cross-section in these prior aerators have represented a significant problem in the art of concealed aerators.

Disclosure of Invention

Accordingly, I have invented a concealed aerator which increases the cross-section of outflow from the aerator. Specifically, the present invention provides a tubular means having an upstream portion and a downstream portion that terminates at a mouth or outlet from which a stream of liquid flows. Recessed upstream from the mouth is a screen. By recessing the screen, the diameter of the mouth can be increased to increase cross-sectional flow. Further, by providing a single element for coupling the aerator to the spout and for abutting the aerator against a lateral lip of the spout, less space is required for the aerator and the flow cross-section can further be enhanced.

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The combining of elements is of particular importance in a first embodiment of the invention in which coupling is achieved by a male threading on the upstream portion which engages female threading on the inside surface of a spout or faucet or the like. The combining of elements in this embodiment means that less space is taken up by the aerator and more space is available through which liquid, such as water, can flow. In addition to enhancing flow by combining elements, this embodiment also provides that the diameter of the male threading be no more than the outer diameter of the downstream portion of the tubular member.

Brief Description of Drawings

Figure 1 is a front corss-section view of one embodiment of the invention which includes a "slotted" aerator having a tubular element with a male threaded upstream portion.

The upper half of Figure 2 is a bottom view of the downstream portion of the aerator of Figure 1 with the screen removed. The lower half of Figure 2 is a top view of the upstream portion of the aerator of Figure 1 with the perforated disk removed.

Figure 3 and 3A shows a front cross-section and bottom view of a second embodiment of the invention which includes a slotted aerator having a tubular element with a male threaded downstream portion.

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Figure 4 shows a front cross-section view of a third embodiment of the invention which includes a slotless aerator and a tubular element with a male threaded downstream portion.

Figure 5 shows a partial front view of another embodiment of the invention.

Figure 6 and 6A show front cross-section views of yet another embodiment of the invention having a tubular element with a male threaded annular flange along its downstream portion and having a screen which is movable up and down within the interior of the tubular element.

Best Mode for Carrying Out the Invention

In Figures 1 and 2, one embodiment of the invention is shown. A spout 100 is shown having a concealed aerator 102 contained therein. The aerator 102 includes a jet forming element 104 which confines an incoming flow of liquid under pressure to longitudinal apertures 106 therein. The liquid flow from the jet forming element 104 passes by an air intake element 107 and proceed in a downstream direction to a metal screen 108 having a circular cross-section and a longitudinal axis. The liquid flow which reaches the screen 108 has air from the air intake element 107, entrained into the flow. The screen 108 mixes the liquid and the air. Encircling the screen 108 and integrally connected to the jet forming element 104 is a tubular element 110, which has an upstream

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portion 112 and a downstream portion 114. The downstream portion 114 extends toward the opening of the spout 100 and terminates with an annular rim 116. The annular rim 116 defines a mouth 118, or outlet, from which a stream of liquid exits the aerator 102. It will be noted that the screen 108 is recessed in the upstream direction from the mouth 118 of the aerator 102. In particular, the screen 108 is held in the recessed position by a shell 120 of the tubular element 110. The recessing of the screen 108 serves two functions. First, liquid passing through the screen 108 can increase in cross-section before reaching the mouth 118. Second, a coin 122 may be inserted into slots or indentations 124 and 126 without being obstructed by the screen 108. The indentations 124 and 126 are formed at opposite positions on the annular rim 116 and are aligned with each other and may have a tapered contour to accomodate the coin 122 (see Figure 2). Once inserted, the coin 122 may be rotated about the axis A to couple or decouple the aerator 102 to the spout 100. In accordance with this embodiment, a perforated disk 129 is provided. The disk 129 serves as a flow restrictor. Referring now to the upstream portion 112 of the tubular member 110, male threading 128 is shown engaging female threading 130 of the spout 100. The upstream portion 112, which is threaded, it will be noted, also serves to abut a lateral lip 132 of the spout 100 (via the disk 129). It will also be noted

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that the diameter of the male threads on the upstream portion 112 is less than or equal to the outer diameter of the tubular element 110 along its length. Also, the flow cross-section through the jet forming element 104 is less than that of the screen 108, the spout 100 being dimensioned to accomodate a screen 108 of large relative diameter. These features help assure that the flow cross-section does not decrease or become restricted in the downstream direction. As suggested by the drawing of Figure 1, the upstream portion 112, the air intake element 107, and the downstream portion 114 (which comprise the tubular element 110) are integrally molded into a unitary structure with the jet forming element 104. Also as suggested by Figure 1, the unitary structure is plastic.

Referring now to Figures 3 and 3A, a second embodiment is shown. Herein, the downstream portion 132 of an aerator 134 includes a male threaded annular flange 136 which engages female threading 138 of a spout 140. Two air passage elements 142 and 144 are provided as integral portions of a tubular element 146. The embodiment of Figure 1 and the embodiment of Figure 3 each provide a slot S by which air can enter the interior of the tubular element 110 or 146, respectively. These two embodiments are referred to as "slotted" aerators. Referring back to the embodiment of Figure 3 and 3A, it will be noted that, the upstream portion of the tubular element 146 presses a disk 150 against a lateral lip 148

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to close off the slot S while the downstream portion 132 provides the coupling function. The two functions are performed by elements (i.e. a disk 150 and the threaded flange 136) which, it should be realized, are axially rather than radially spaced, thereby enhancing available flow cross-section.

Referring now to Figure 4, a slotless aerator 200 is shown as a third embodiment. In this embodiment the downstream portion 202 of a tubular element 204 has a male threaded annular flange 206 integrally molded thereto. The spout 207 has female threading 208 adapted to accomodate a standard aerator which is not concealable. The male threading of the annular flange 206 also corresponds in complement to the female threading 208. A washer 210 is interposed between the annular flange 206 and lateral lip 212. An air inlet element 214 provides a path for air outside the spout 207 to be introduced into the liquid flow exitting a jet forming element 216. Prongs 218 hold a screen 220 in place. The screen 220 resides in a shell 222 which is force-fit against ribs 224. Air passes between the shell 222 and a wall 226. The embodiment of Figure 4, like the previously discussed embodiments, provides that the screen 220 be recessed relative to the mouth 228. A coin 230 is shown fitting into indentations 232 and 234 which are contoured to accomodate insertion of the coin 230. Rotation of the coin 230 about the aerator axis (not shown) couples or

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decouples the aerator 200 from the spout 207. The recess also provides an area in which the cross-section of the liquid flow or stream may increase before exitting the aerator 200 and spout 207.

Figure 5 shows another embodiment which has male threading 236 along the outer peripheral surface of the upstream portion 238 of a tubular element 240. In Figure 5, inflow to a jet forming element 242 is significantly enhanced, the flow path extending into an area cutaway from the inner surface of a spout 244. It should be noted that the aerator 246 of Figure 5 is substantially although not totally, concealed by the spout 244. A screen 248 of the areator 246 is force-fit into a recessed position. Knurled ends 250 are provided to aid in screwing and unscrewing the aerator 246 to the spout 244.

Referring finally to Figure 6 and 6A, a last embodiment is shown. A shell 300 is surrounded by longitudinal ribs 302 (see Figure 6A) extending along the inner surface of a tubular element 304. Each longitudinal rib 302 has an end 306 (see Figure 6A) turned radially inward. Contained within the shell 300 is a screen 308 which can move up and down in a longitudinal direction. In Figure 6A, the screen 308 and shell 300 are at the end 306 of the longitudinal rib 302. Further downward movement of the shell 300 is prevented by the ends 306. When a coin 310 of Figure 6 is inserted into

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indentations 312 and 314 of a pair of ribs 316 and 318, respectively, the screen 308 rides upwardly to a recessed position. The coin 310 may be turned about the axis of aerator 320 to couple or decouple the aerator 320 to a spout 322. Provision for force-fitting the shell 300 against the inner surface of the tubular element 304 may be included as desired. Otherwise, the shell 300 is free to move up and down with the insertion or removal of coin 310. Gap 324 is provided to permit the end 306 to be heatbent as an alternative to molding the end 306. As in the previous embodiments, a jet forming means 326 may be integrally formed with the tubular element into a unitary structure formed of plastic.

The various discussed embodiments thus teach the combining of a jet forming element and a tubular element into a low cost, plastic molded unitary structure which obviates the need for the costly metal casing employed by many prior aerators. The embodiments also teach increased flow cross-section by making the cross-section of the tubular element interior at the screen larger than the effective diameter of the jet forming element which is upstream therefrom. In addition to lower cost, greater flow cross-section, and improved appearance due to the concealment feature, the embodiments also teach ease of aerator insertion by use of a coin or a knurled element.

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Various modifications, adaptations and alterations to the present invention are of course possible in light of the above teachings, in addition to those set forth specifically. It should therefore be understood at this time that within the scope of the appended claims the invention may be practiced otherwise than as specifically described hereinabove.

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Claims

1. An aerator for introducing air into a liquid flow passing under pressure through a spout having an inside surface of circular cross-section, the aerator being substantially concealable within the spout, the aerator comprising:

means for forming the liquid flow into jets;

a screen of circular cross-section through which the outflow from the jet forming means passes; and

a tubular element having an inner surface, an outer peripheral surface, and means disposed along the outer peripheral surface for engaging the inside surface of the spout;

wherein the tubular element includes (a) an upstream portion, (b) a downstream portion having, at the end thereof, an annular rim which defines a wide cross-section mouth at the end of the downstream portion, the mouth cross-section exceeding the effective jet forming means outflow cross-section, and (c) means for recessing the screen to a position in the tubular element proximate to the upstream portion.

2. The aerator of claim 1 wherein the jet forming means and the tubular means comprise a single integrally molded element which is dimensioned to be substantially concealably insertable within the spout, the jet forming means being integrally molded to the upstream portion.

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3. The aerator of claim 2 wherein the single integrally molded element consists of plastic.

4. The aerator of claim 2 wherein female threading is provided upstream within the spout and the engaging means comprises:

male threading formed about the outer peripheral surface at the upstream portion of the tubular element, the male threading being complementary with the female threading of the spout.

5. The aerator of claim 4 wherein the outer peripheral surface along the upstream portion of the tubular element has an outer diameter no greater than the outer peripheral surface along the downstream portion of the tubular element.

6. The aerator of claim 4 wherein the tubular element is provided with air intake elements which permit air from outside the tubular element to enter the interior of the tubular element.

7. The aerator of claim 4 wherein the spout upstream from the recessed female threading has an annular lip disposed radially inward from the inside surface of the spout, the inner diameter of the lip being less than the diameter of the female threading, the aerator

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further comprising:

a perforated disk having an outer annular portion which is sandwiched between the annular lip of the spout and the upstream portion of the tubular element.

8. The aerator of claim 3 wherein the spout is provided with female threading and the engaging means comprises:

a male threaded flange extending from the outer peripheral surface at the downstream portion of the tubular element, the male threading being complementary with the female threading of the spout.

9. The aerator of claim 8 wherein the spout upstream from the female threading has an annular lip disposed radially inward along the inside surface, the inner diameter of which is less than the diameter of the female threading and wherein the outer peripheral surface of the tubular means and the inside surface of the spout have a slot defined therebetween, the aerator further comprising:

a first air passage element in the downstream portion, the first air passage element providing a path for air outside the spout to the slot;

a second air passage element in the upstream portion, the second air passage element providing a path for air from the slot into the interior of the tubular element; and

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a disk having an impervious outer annular portion which is sandwiched between the annular lip of the spout and the upstream portion of the tubular element, the disk preventing air in the slot from passing between the annular lip and the upstream portion.

10. The aerator of claim 2 wherein the spout is provided with female threading and the engaging means comprises:

a male threaded annular flange projecting radially outward from and being integrally molded to the outer peripheral surface at the downstream portion of the tubular element, the male threading on the annular flange being complementary with the female threading.

11. The aerator of claim 10 wherein the outer peripheral surface is impervious to air; and

wherein the tubular element further comprises a plurality of air inlet elements, positioned inward relative to the outer peripheral surface, through which air from outside the spout enters the interior of the tubular element.

12. The aerator of claim 11 including a shell which encircles and contains the screen; and

wherein the inner surface of the tubular element has a diameter slightly larger than the shell, permitting a force-fitting of the shell to the tubular element.

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13. The aerator of claim 4 wherein the annular rim has two aligned indentations provided therein at opposite portions of the annular rim.

14. The aerator of claim 13 wherein the indentations are spaced and dimensioned and the screen is recessed sufficiently such that a coin is insertable into the indentations.

15. The aerator of claim 4 wherein the aerator further comprises:

wall means, disposed along the inner surface of the tubular element, for engaging the circumferential surface of the screen and for retaining the screen recessed within the interior of the tubular element.

16. The aerator of claim 10 wherein the aerator further comprises:

a plurality of longitudinal elements extending along the inner surface of the tubular element, the longitudinal elements having downstream ends turned radially inward; and

wherein the screen is (a) movable longitudinally within the interior from a downstream position to the recessed position and (b) contained within the interior by the downstream ends of the longitudinal elements.

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17. The aerator of claim 16 wherein the annular rim has two aligned indentations provided at opposite portions of the annular rim.

18. The aerator of claim 17 wherein the indentations are spaced and dimensioned such that a coin is insertable into the indentations.

19. The aerator of claim 4 wherein the downstream portion has knurled ends extending beyond the end of the spout.

20. An aerator concealably insertable within a spout through which liquid under pressure flows, the aerator comprising:

means for introducing air into the liquid flow;

a screen, having a circular cross-section and a longitudinal axis, through which the liquid flow with air introduced therein passes; and

a tubular element having a hollow interior of cross-section larger than the cross-section of the screen, the screen being free to move longitudinally within the hollow interior.

21. The aerator in claim 20 wherein the tubular element includes means for confining the screen to movement only within the hollow interior.

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22. An aerator substantially concealable within a spout through which fluid under pressure flows, the aerator comprising:

means for forming the liquid flow into a plurality of jets, the jet forming means providing a flow having a first cross-section;

means for introducing air into the liquid flowing from the jet forming means; and

a screen of circular cross-section through which the liquid flow with the air introduced therein passes, the screen having a screen diameter wherein the flow through the screen has a second cross-section which is greater than the first cross-section.

23. A spout through which liquid flows in combination with an aerator substantially surrounded by the spout, the aerator comprising:

means for forming the liquid flow into a plurality of jets, the jet forming means providing a flow of a first cross-section;

means for introducing air into the liquid flowing from the jet forming means; and

a screen of circular cross-section through which the liquid flow with the air introduced therein passes, the screen having a screen diameter wherein the flow from the screen has a second cross-section which is greater than the first cross-section; and

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the spout has a first inner diameter where the spout surrounds the jet forming means and a second inner diameter larger than the first inner diameter where the spout surrounds the screen, the second inner diameter being sufficiently large to accomodate the screen.

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FIG. 1

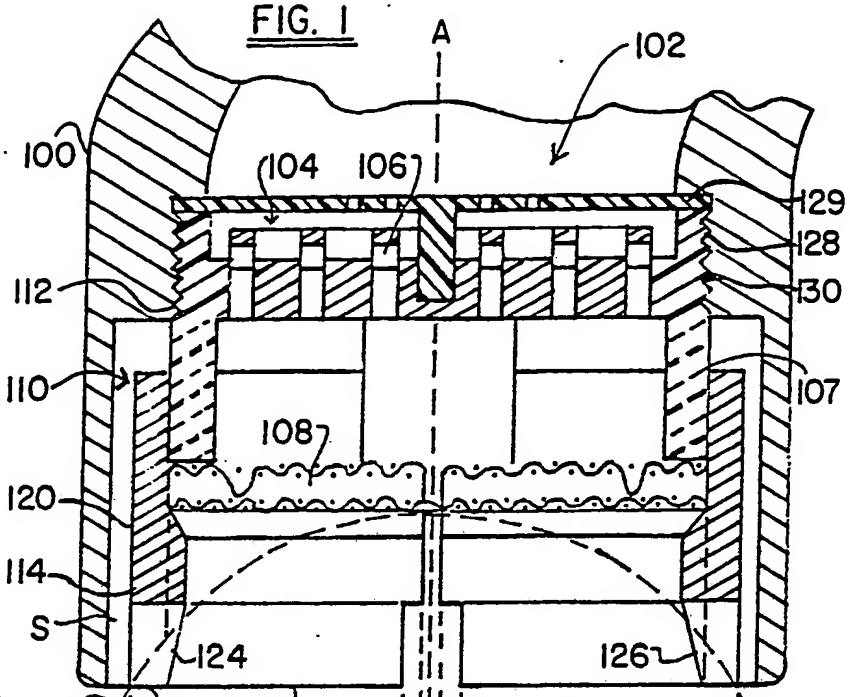

FIG. 3

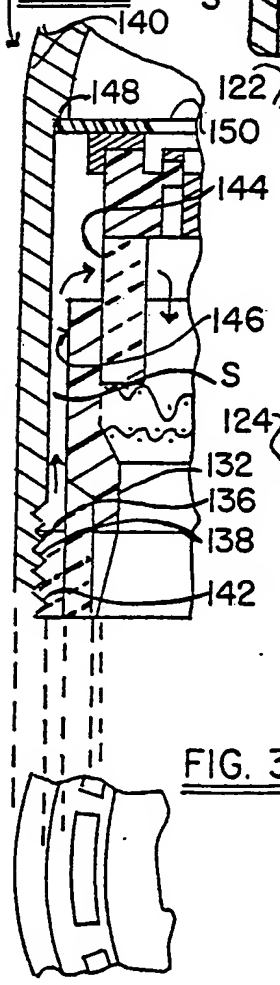

FIG. 3-A

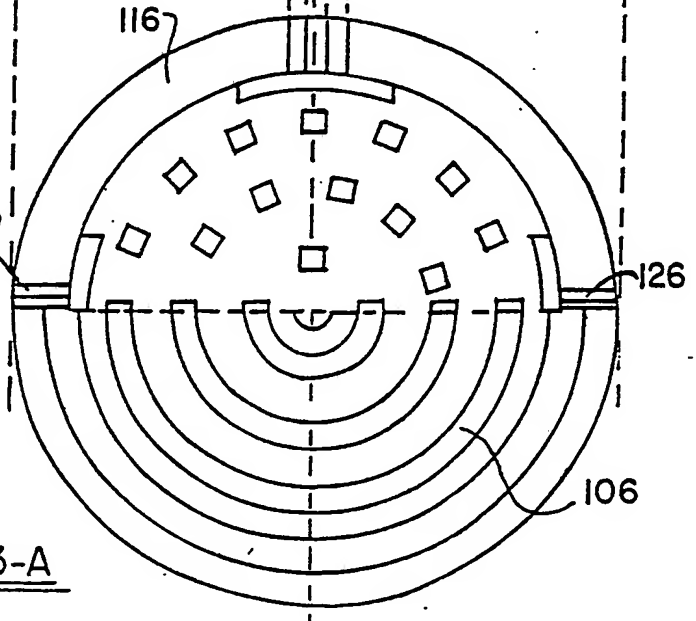

FIG. 2

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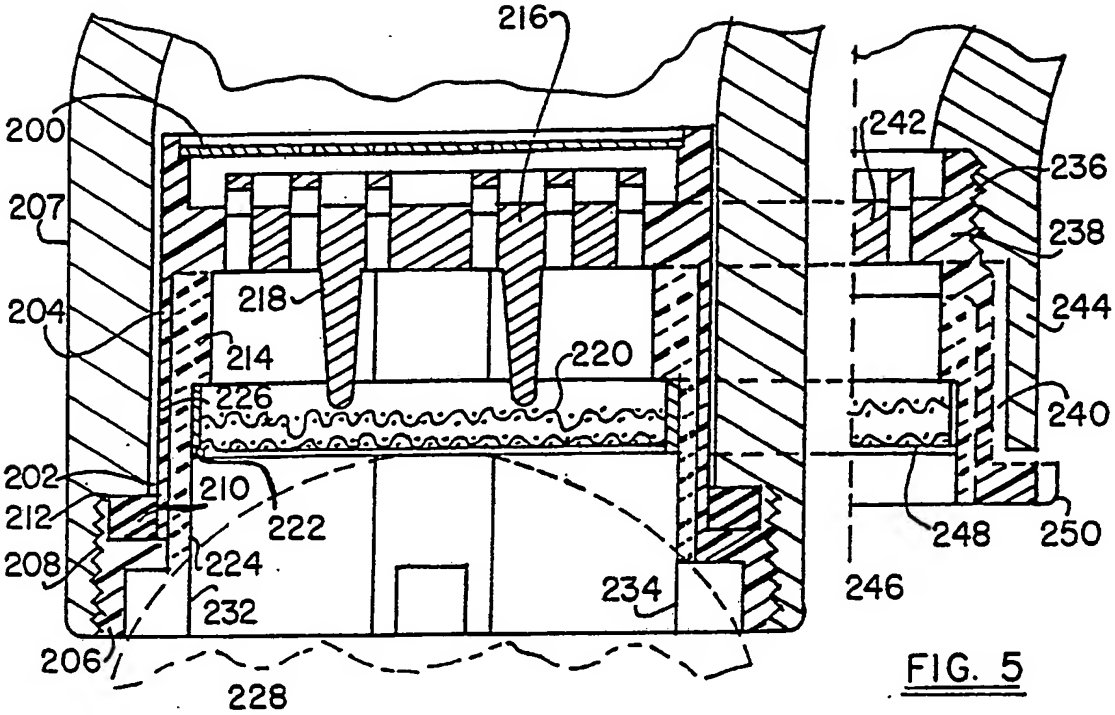

FIG. 5

FIG. 4

FIG. 6

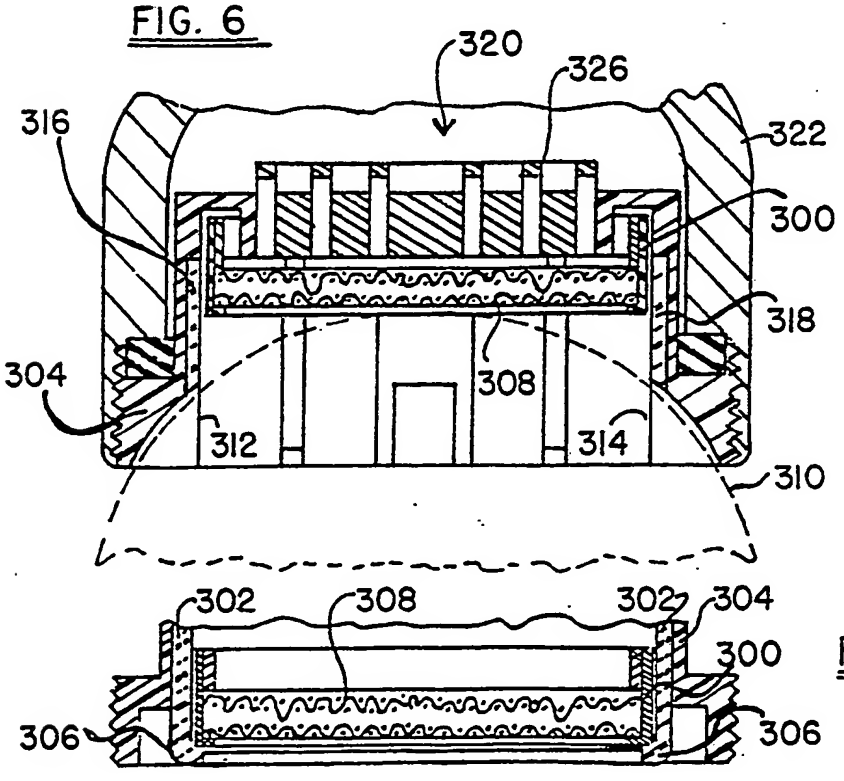

FIG. 6-A

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INTERNATIONAL SEARCH REPORT

International Application No PCT/US81/01341

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

U.S. Cl. 239/428.5 Int. Cl.[3] E03C 1/084

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
U.S.	239/288-288.5,428.5, Digest 18 261/Digest 22

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
X	GB, A, 1,189,550 Published 29 April 1970, Consider Figures 2 and 4, Aghnides.	1-6,22-23
A	US, A, 3,067,951 Published 11 December 1962, Consider Figure 1, Aghnides.	7
X	US, A, 3,298,614 Published 17 January 1967, Consider Figures 4-5, Aghnides.	1,3-6,8,10-12 15,19,22-23
A	US, A, 3,014,667 Published 26 December 1961, Consider slots 23, McLean et al.	13-14,17-18
A	US, A, 3,279,702 Published 18 October 1966, Consider Figures 3-4, Aghnides.	15-16
X	CH, B, 428,595 Published 14 July 1967, Consider Figure 4, Aghnides.	15,20-21
A	US, A, 3,363,841 Published 16 January 1968, Consider Annular Passage Between Walls 41-42, Aghnides.	11
	US, A, 3,270,965 Published 06 September 1966, Consider Figures 4-5, Aghnides.	

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IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
22 December 1981	07 JAN 1982
International Searching Authority [1]	**Signature of Authorized Officer [20]**
ISA/US	Andres Kashnikow Andres Kashnikow

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